The War on the Mosquito. Publication No. 11.

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First Measures in Malaria Prevention for Farmers and Settlers.

The Role of Nature in the Suppression of Malaria.

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BY

G. G. HAY, M.B., Edin.

Zoutpansberg, Transvaal.

Written specially for, and Published by

The South African Anti-Malarial Association,

P.O. Box 2879, Johannesburg.

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I. FOREWORD.

In whatever part of the world men have set out to find new homes in strange lands, no obstacle has been so constantly in the way of their progress as the disease which we call malaria.

This disease has been known from the most ancient times in England and on the continent of Europe. The white races spreading to the East, to America, both North and South, to Africa, and to the Islands of the Sea found it in greater or lesser degree wherever they went.

Therefore, as the ages rolled on, an enormous amount of experience gradually collected with regard to it, and this experience pointed to one law without a knowledge of which much of the best country in the world would to-day be unoccupied, or occupied only by native races. This fact or law may be briefly stated thus : " The first years are the worst years ; " before the industry, civilisation, and cultivation of the white " man, malaria gradually disappears, or becomes less frequent " and less severe."

For illustration of this rule it is unnecessary to go far afield. Thirty years ago Pretoria was a hot-bed of malaria ; it still occurs a little to the north of the town, but it is superfluous for me to say that to-day the town itself is healthy. In Potgietersrust, now a flourishing township, half the population died in a single season. Pietersburg, now advertising itself as a health resort, had twenty years ago half its citizens incapacitated each summer. In Schoemans-dahl, the earliest outpost of civilisation in this district, the first band of pioneers was practically annihilated. Durban was malarious, and only the other year had an epidemic of the disease. Delagoa Bay, once notorious, is fast becoming a pleasure resort.

And the same tale has to be told of the districts. In the beautiful valley of Mooiplaats, near Louis Trichardt, malaria ten years ago was found in the summer in every farm house, and was of a severe type—to-day the cases are infrequent and the type mild.

Missionaries, of various denominations, were amongst the earliest pioneers in this district. If you wish to hear tales of

the disease, ask at any of the stations which you will find dotted over the veld. One, in particular, rises to memory, though only a sample of the others. Here, as to-day the missionary meets you with kindly courtesy and offers you his generous hospitality, healthy and vigorous children play about the stoep, yet mosquito netting and the modern means of prevention are nowhere in evidence. Question your kindly host, and he will show you no less than three disused graveyards. Each marks a site where his predecessors attempted to found a station. But they were driven back by their relentless and sleepless foe from position to position, until at last they found a stronghold healthy enough to hold securely against the enemy.

The suffering and loss of life caused by malaria first drew attention to the problem of the cure of the disease; the success of colonisation and cultivation in lessening its ravages directed the minds of investigators to the problem of its causes.

The former problem was first solved by the discovery of quinine, a drug the effects of which are one of the marvels of medicine.

The solution of the latter problem was longer delayed, but surely, if slowly, knowledge accumulated, until to-day the matter rests on a secure and tested foundation—tested indeed both by nations and by individuals in all quarters of the globe. Briefly stated in this place, the solution is: MOSQUITOES CARRY THE DISEASE FROM MAN TO MAN; THEREFORE MALARIA CAN BE PREVENTED BY EXTERMINATING MOSQUITOES OR BY PROTECTING MAN FROM THEIR BITES.

Along the Eastern line of Railways (Komatipoort) the authorities have attacked the mosquitoes in their haunts by draining the pools of water around the stations in which young mosquitoes were found; in suitable situations they have poured oil on the water and so suffocated the young insects; by the use of wire gauze they have rendered the quarters of their staff mosquito proof. By these measures the reduction of sickness has been enormous, and the country has been saved many thousands of pounds.

In building the Selati line, Messrs. Pauling carried out similar measures at Newington, their base, a notorious fever place. Here again marked success followed. So marked indeed that out of a large resident staff no new malarial infection was acquired.

I can well imagine the reader exclaiming at this point: Yes, that is all right for rich railway corporations and contractors, but what about me? My most valuable worldly possessions are a stout heart and a strong right arm. Yet my people are pushing out East and West and North. The healthy

parts are most strongly held. My worldly state compels me to fight the battle of life in parts where this disease flourishes. Can you not tell me how by simple and inexpensive means I can hold the enemy at bay until my worldly state improves, and I can, on up-to-date principles, build my stronghold and bid defiance to the foe.

And this is exactly what I wish to do. TO SHOW THE SETTLER IN HIS NEW HOME, TO SHOW THE FARMER ALREADY SETTLED, HOW, BY UTILISING MAINLY THE FORCES OF NATURE, THE RISK OF MALARIAL INFECTION MAY BE GREATLY DIMINISHED FOR THEMSELVES AND FOR THEIR FAMILIES. The examples I cited were only adduced as proof that that which I said was true. What has been done can be done again. If the man on the veld has not the resources of the South African Railways, he has proved over and over again that he can always " een plan maak " to meet his needs, and it is this plan that I wish to discuss with you in this paper.

II. MALARIA—THE DISEASE.

The Disease.

As the disease attacks the new-comer, it generally begins by the patient feeling unwell, perhaps dizzy, perhaps sleepy. Or he may feel sick. He may have headache, or pains in the back, especially the back of the neck, and in the limbs. Presently he shivers, but possibly only slightly, and this is followed by fever and sweating. The fever lasts for three or four days, with now and then fits of shivering of greater or lesser degree.

Common in other countries, but not so common here, are the fits of shivering followed by fever and sweating, and recurring, according to type, every second or every third day.

Besides these, we have complicated cases of fever, as, for instance, high temperature, convulsions, loss of consciousness, and stomach forms. Lastly, we have blackwater, a disease occurring frequently along with malaria, but of which the exact cause is unknown.

Effects of Malaria.

The simpler forms of malaria are not deadly, but very important, as causing great loss of time and of work. The other forms are more serious, but this we can say, that they are more frequently seen, apart from wanton exposure to infection without precautions and on improper food for a considerable time, after exposure to one or more of the aggravating causes to be referred to later.

Where found.

This question could possibly be most easily answered by saying where it is not found, only this also is difficult, because every now and then, as circumstances favour its development, it appears in epidemic form in places where it does not usually occur. The bush veld is malarious, and of course the low veld. In this district the fever, in greater or lesser degree, extends to all places less than 5,000 feet above sea level. Practically all the vast unoccupied tracts in the Waterberg, Pietersburg, and Zoutpansberg districts are malarious. To enumerate all the places in the Union where the disease is found would be simply to write a long list—I mention these merely as examples with which I am personally more or less familiar.

Peculiarities.

Two peculiarities of this disease may be here mentioned—(1) when a person becomes infected, it can happen in certain cases that he carries the infection in his blood, and that it may only break out many months after he has left the place where he acquired it; (2) when a person has had the disease and treatment has not been sufficiently vigorous, then he is liable to relapses, even after he has left the district where he became infected. These conditions are called by doctors latent malaria and latent infection.

The Cause of Malaria.

When a doctor wishes to make certain that a patient is suffering from malaria, he takes a portion of the blood and examines it under a microscope. If malaria is the cause of the illness, a small organism will be found in the blood. This organism is found only in the systems of malaria patients. This organism is like any other animal—it is classified as a very minute animal—it lives, it increases, it dies. When we find it in a patient, therefore, we know that it did not originate there; it must have been brought from the body of some other person. This latter is the part of the mosquito; it finds the organism in a diseased person and carried it to a healthy person.

Things to be studied.

In considering a case of malaria, therefore, three things must be noted :—

(1) THE SOURCE OF THE INFECTION—ALWAYS A HUMAN BEING.
(2) THE CARRIER OF THE INFECTION—THE MOSQUITO.
(3) THE VICTIM—ALWAYS A HUMAN BEING.

III. SOURCE—CARRIER—VICTIM.

(1) THE SOURCE OF THE INFECTION.

The ultimate source of infection, by far the most frequent source in the Transvaal, is the native population. Scientists apply the word " reservoir " to denote a supply such as this, and an inexhaustible reservoir it proves to be. Early in childhood the native becomes infected, and for years he undergoes repeated infections, but he emerges from it, and although his protuberant abdomen may mean a large spleen, he appears to enjoy rude health. The malaria parasite, however, remains in his blood until early adult years and often longer. During the whole of this time he is exposed to the attack of and frequently bitten by mosquitoes. Every time he is bitten he potentially infects a mosquito, which a short time later can infect a European or a susceptible native.

The remedy is very simple; PUT YOUR NATIVE STADTS AS FAR AWAY AS POSSIBLE, AND MAKE ALL HOUSE BOYS AND NATIVE DOMESTICS SLEEP AT A LITTLE DISTANCE FROM THE HOMESTEAD.

To remedy this, as well as other disabilities, our most thoughtful farmers have been working in the direction of segregation. By this they mean that a part of the farm is set aside entirely and generally fenced off for the use of their natives. In this portion they build their huts, till their gardens and keep their stock. By this means they and the farmer come into contact only when essentially necessary. If the natives, in their person or in their stock, harbour any source of disease, the farmer's risks are much lessened.

Other possible sources are the persons who harbour the parasite without having ever had a definite attack of the disease, and the person who is subject to relapses. These, however, are, compared to the native source, unimportant. But the moral is evident—when sickness actually does occur, have it treated until your doctor is satisfied with the result, and if a relapse should occur take more energetic measures still.

A person sick of the disease is a further source of infective material. THEREFORE TO AVOID INFECTING MOSQUITOES SUFFICIENT TO PASS THE INFECTION ON TO SOME OTHER MEMBER OF THE FAMILY, BUY, BEG, BORROW, OR STEAL A MOSQUITO NET AND KEEP THE SUFFERER UNDER IT UNTIL RECOVERY IS COMPLETE.

(2) THE CARRIERS OF THE INFECTION.

The Mosquito.

To understand our subject we must now study at some length the habits and mode of life of our carriers—the mosquitoes.

The man in the street is apt to distinguish two kinds of mosquito—the " singing " and the " silent." The " silent " is not entirely silent, but it is certainly much less noisy than its " singing " relative. IT IS THIS SILENT MOSQUITO WHICH

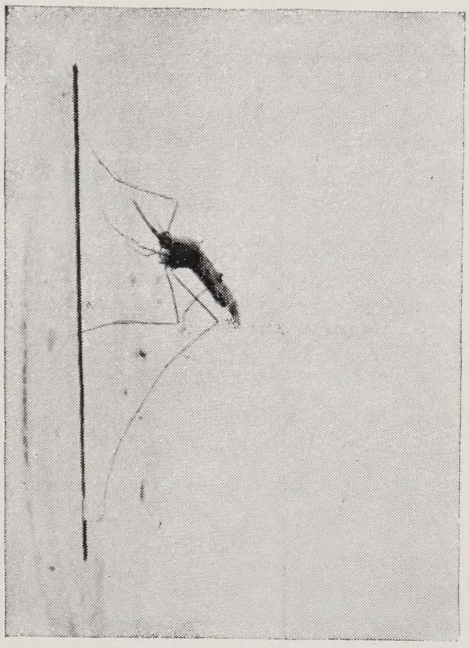

FIG. 1.

Anopheles Mosquito—a carrier of malaria (slightly enlarged). Note the acute angle to the wall at which the body rests.

CARRIES MALARIA. Quite a funny little thing it is—full of all sorts of fads and ideas—it looks as if it rather fancied itself, and indeed it well may if mischief-making counts for anything. It has well been called the " aristocrat " among mosquitoes.

It begins life in the water, not, mind you, like its relatives, in any old broken bottle or tin or tree trunk. No, it must have mother earth for a cradle. It does not like running water nor the inner parts of ponds and dams. It is generally found along the edges among the tufts of grass and rushes. Hence it is particularly fond of vleis. It is also found in puddles of still water on the ground, as, for instance, the puddles in a ploughed field after rain or after irrigation. Two things therefore it insists on and will have, viz., mother earth and still water.

But it must not be imagined that the mosquito's lot is entirely a happy one. The struggle for existence is fierce, and man has many allies in the fight for its extinction. Before it leaves the water, fish are its most deadly enemies, and it has many fights with its own species, for, alas, among its near relatives we find actually cannibals. The young of the dragon-fly, the whirligig beetle, water spiders, and water scorpions all attack it. Nor when it takes to the wing are its troubles over, for here it is at the mercy of birds, bats, spiders, dragon-flies, and lizards. It is further subject to disease, having been found to harbour a worm and to be affected with a fungus.

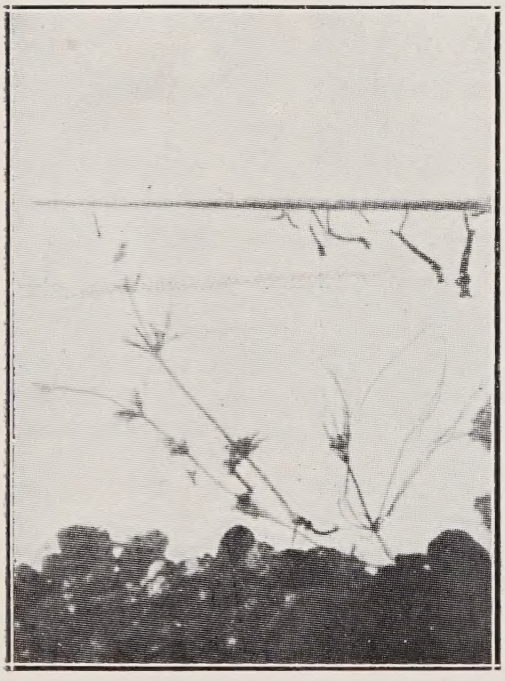

FIG. 2.
Appearance of mosquito larvæ in water. Side view of Culex larvæ resting at surface.

FIG. 3.
Larvæ of Anopheles Mosquito seen from above surface of water.

The food of the mosquito is, in the adult stage, the juice of plants, with an occasional meal of blood at the expense of man. Only, let it be known at once, to the credit or otherwise of our silent friend—every lady is a militant suffragette and every gentleman a suffragist—this meal of blood is for the female only.

That is to say—it is the female mosquito alone which bites and therefore which alone distributes malaria.

How the mosquito bites.

Let us see what may happen when she attacks man. If the sting of a mosquito be dissected, two tubes will be found. When the bite is inflicted, then both these tubes are used—tube No. 1 and tube No. 2. Tube No. 1 is connected with the sali-

vary glands and conveys saliva; tube No. 2 is connected to the stomach and through it the insect sucks up the food. In man and animals the saliva moistens the food, and helps in the first stages of digestion. In the mosquito it has a further function; it keeps the blood of the victim fluid for a time, and it is the blood thus kept fluid which is drawn up through tube No. 2. There are therefore two distinct processes in feeding—firstly, saliva is injected to keep the blood fluid until, secondly, it can be readily drawn into the body of the insect.

Modes of Increase of the Organism.

We have said that the minute organisms which cause malaria, being in reality very minute animals, increase like other animals. But there is this difference, that they increase in two distinct ways—the sexual and the non-sexual. The sexual increase takes place in the body of the mosquito. Long before the mosquito was dreamt of as the distributing medium, scientists had noted, when examining smears of the blood of persons sick with malaria, two forms of the malarial parasite, which they took to be male and female forms. And when the bodies of mosquitoes were searched systematically under powerful microscopes, one of the first things seen was the union of these forms and the subsequent appearance of their progeny. These latter were next traced from the stomach of the mosquito to the salivary glands, there to await an opportunity of entering the body of man.

The asexual mode of reproduction takes place in the human body. Minute organisms like those we are now studying have no separate heart or lungs or liver or other highly developed organ. They are merely pieces of matter with one or two distinct or special spots in them. Hence they can increase by simply cutting themselves in two, and each part continuing its now separate life. This constitutes the asexual or non-sexual mode of reproduction.

How the infection takes place.

Suppose there are malaria parasites in the blood of a person, our suffragette comes along and inserts her sting into the skin of her victim. Immediately through tube No. 1 saliva is poured in and keeps the blood fluid, so that it can continue to be drawn through tube No. 2 into the stomach until the insect has had her fill. In the body of the insect, the organisms drawn in with the blood unite, increase and pass to the salivary glands. All this of course takes some days. Suppose now, the mosquito finds a second victim to bite when the organisms have reached the salivary glands. Then, along with the saliva she introduces those minute organisms, which increasing a million-fold, cause an attack of malaria.

In another light.

Look at the subject from another light—the elaborate pains nature takes in preserving and propagating this, to us, entirely noxious and useless organism. She chooses an insignificant insect—the mosquito—of that only one species—and of that species again only the female sex.

She provides her with means for keeping the blood of the victim fluid until the insect has drunk her fill. Since relatively a small number can in this manner be introduced into the stomach, she provides a sexual mode of increase and so increases the numbers within the body of the mosquito. Again, since opportunity can only be afforded for introducing a relatively small number into the body of each person bitten, she arranges a non-sexual mode of reproduction in order to provide the enormous number of organisms found in the blood in the case of malaria.

Here let me digress to say that malaria is not a disease of mosquitoes—that they merely as it were pass it on without apparent injury to themselves.

Habits of Mosquitoes.

Our "silent" friend is most in evidence in summer—that is the warmer the weather the better it suits it. The winter it can pass sleeping in some secure, preferably dark and shady, place. It is also at night that it is most active—just at sunset and before sunrise. When it comes into a dwelling it likes to enter about 8 or 9 o'clock and to leave in the early morning. But it will stay if it finds things to its liking. Thus it does not like light colours, say whitewash, but to settle in dark clothes in a wardrobe or on other dark surfaces suits it well.

It is by night also that our friend bites—with this important exception, that in dark rooms or in dense shade, it will bite also in the day-time. It has also been known to bite by day-time in rainy weather.

The life of a mosquito begins when a female lays the eggs in the still water these insects like so much. Before leaving the water, and before it takes to the wing, it passes through two worm-like stages. The time from the laying of the egg till the adult state is assumed, may be only two days. This shows how important temporary puddles of water may become. Its whole span of life may be only ten days, though it has been computed at from 30 to 50 days. In places like South Africa where there is a definite cold season, impregnated females can hibernate through the winter in any cave, cellar, dwelling or other secure place. The female, generally, lives longer than the male. It is not strong on the wing, and unless aided by

strong winds does not move more than 1,000 yards from its birthplace. It is not a high flyer—rarely rising more than a few feet from the ground.

Avoidance of the Carriers—What to consider when building the Farm House.

Having in the last section studied the habits of mosquitoes, we must next consider where best we can place the residence if danger from these insects is to be reduced to a minimum. For the sake of completeness I write as if the house were about to be built, but the farmer who wishes to minimise his risk of infection can apply such of the lessons as can be made to suit his case.

In the above connection we have to consider :—

(a) Rivers, Water-courses, Vleis.

With regard to rivers, they are generally stocked with fish, which feed upon the young mosquitoes, and practically keep the pools free. Further, they contain, generally, strongly running water, which the insects dislike.

The pools in water-courses are worse, but if stocked with fish these also are not dangerous. The dangerous pool, and the one most difficult to manage, is the pool of still water not stocked with fish and disconnected with the river. If fish can be introduced, they are probably the most effectual means of dealing with the problem.

Carp are now widely distributed over the Union. They can be obtained from the Government Hatcheries under the administration of the Cape Provincial Council, and easily transported to any place within a reasonable distance of a railway. Besides destroying, like all fish, the larvæ of the mosquito, they form an excellently wholesome article of diet, varying the menu of the Low Veld and making for health. An endeavour has been made by the S.A. Anti-Malarial Association to introduce the West Indies fish, popularly known as "Millions," which are reputed to be of great value as enemies of mosquito larvæ. The "Millions" belong to the top-minnow variety of fish, and, being very tiny, can penetrate into the shallowest water and amongst the reeds and grasses where larger fish cannot go, and where as a rule the mosquito loves to lay its eggs. Some time must elapse yet before it can be said conclusively that the attempt to acclimatise the "Millions" has been a success or otherwise. Certainly they have not succeeded in establishing themselves in the colder waters, but there is reason to believe that considerable success has attended the experiment in Natal and Zululand, and from there it may be possible to extend them gradually to the Low Veld.

Recent American experience shows that ducks, too, destroy large numbers of mosquito larvæ. This gives the farmer one more helper in his fight to clear the dam, the pool, and the water furrow.

Vleis are the largest breeding grounds of mosquitoes, and they may be most difficult to tackle.

The vlei and the solitary pool are thus singled out for avoidance. Place the future homestead as far from either as your work will admit of—until you can deal with them at leisure. Further, we have seen that wind materially helps the insects in their flight, thus, for preference, keep to the windward side of these danger spots.

FIG. 4.

Four years' growth—the house can hardly be seen—it is damp, stuffy, and mosquito infested.

By windward I mean the side from which old residents tell you the wind most generally blows.

(b) THE SOIL.

The soil of the building site is most important. CHOOSE THE BEST DRAINING AND MOST POROUS SOIL YOU CAN FIND. This of course you do so that puddles of water will not form after rain, but drain away as soon as possible.

(c) DRAINAGE.

CHOOSE A SITE WITH A GOOD SLOPE—by this means the water quickly drains away from the homestead.

(d) EXPOSURE.

This really means the direction, East, West, or South, which the house is to face, and is one of the first essentials of house planning insisted on by architects. In planning how to escape the nimble mosquito it must be relegated to an inferior position. It is important, however, to place the house high up, but not too high. The tops of rises are apt to be exposed and draughty—two things we specially try to avoid in possibly malarial country. SOME WAY UP THE FACE OF A GENTLE SLOPE IS THE BEST POSITION.

(e) TREES.

Trees should on no account be planted too near the house or so as to surround it on all sides. The effect of such planting

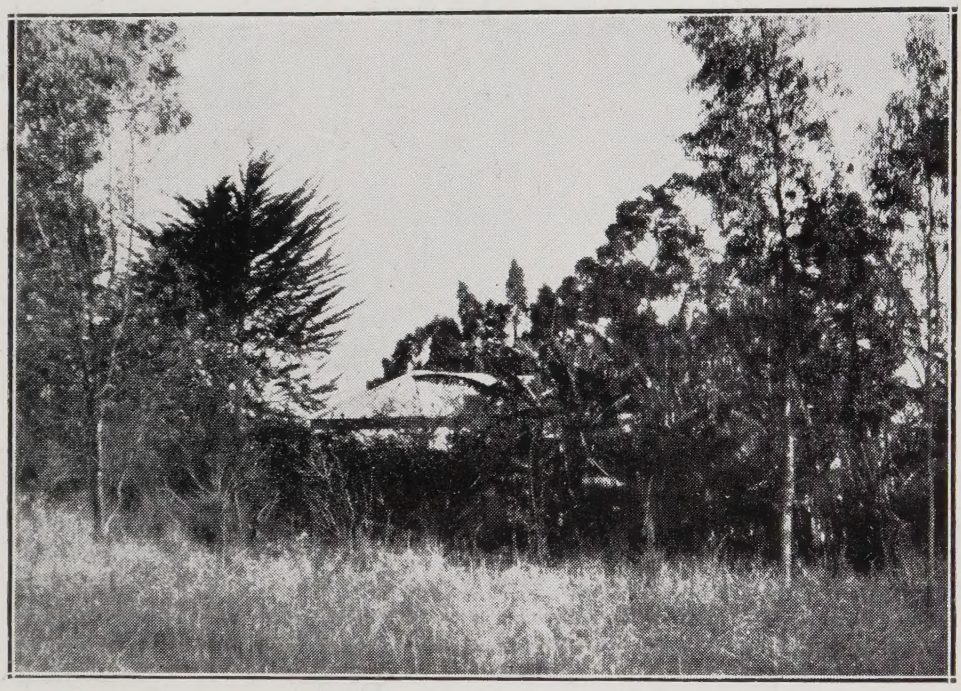

FIG. 5.

The house is enclosed in trees. Every child suffers from fever.

is to keep the ground damp and prevent access of air and light. The shade of the trees allows water to stand in puddles for days, so as to become breeding grounds for mosquitoes. It also gives cover to the insects, and in the gloom of the trees they bite by day as well as night. This may partly explain the fact that the children of the family are, in practice, found to be the first to suffer. The shade is a favourite playground of theirs. I can show you a lovely farm—a show place of the north. But the house is buried in trees, and each child as it reaches the toddling age becomes regularly infected with malaria.

Now it is an accepted fact that a house looks best with trees at the sides and at the back—not in front. LEAVE THE FRONT OPEN, AND AGAIN DO NOT PLANT TOO NEAR THE HOUSE. Further, do not plant too close together; plan that the sun penetrates everywhere and dries up any puddles that may remain after rain.

Avoid trees which feather to the roots, or, if you have them, cut away the lower branches and admit light and air.

Pepper trees are said to be special harbourers of mosquitoes, but this has been contradicted, and I think rightly so. I do not believe they harbour mosquitoes unless allowed to grow so as to give excessive shade.

FIG. 6.

A hint for town planners on what to avoid—Indian " shacks " and bananas in the middle of a village—Ideal shelters for mosquitoes.

On the other hand, I confess bananas are in this respect my pet aversion. The banana grove is a nest of snakes and a breeding place of mosquitoes. It makes for excessive shade and moisture. I know an old Induna who lives in a banana grove. He loses regularly, but I regret to say cheerfully, two of his wives yearly as a tribute to the malaria breeding properties of these trees.

(f) GRASSES.

Into the long grasses the sun cannot shine to dry up the moisture, in which mosquitoes breed, and they at the same time give shade in which the insects lurk by day waiting for night to fall to attack their prey. THEREFORE FROM THE IMME-

DIATE VICINITY OF THE HOME BANISH ALL LONG GRASS. In the first few years use the sickle, but plan that your animals shall one day do the work for you.

Your horse and your mules, your small stock, if paddocked and grazed round the home, will keep your grass shorter than you can cut it with a mower. Further, in a short time, the old rank vegetation will be replaced by short sweet grass, such as animals love. By this means you have destroyed all cover for snakes and vermin. You have also added materially to your comfort by removing the cause of wet feet and of wet trousers clinging to legs and thighs. It is all too common to see huts and houses buried in long grass. It used to be said that if

FIG. 7.

Looking for fever A neglected, carelessly built house, against a banana grove, and surrounded by vegetation. No screening.

you wanted to see the four hundred inhabitants of Louis Trichardt, you must search for their houses amongst the grass.

(g) CULTIVATION.

The first effect of cultivation is apt to be an increase of malaria. This is accounted for by the fact that puddles easily form in newly broken ground after rain, and that in the uneven surface left after first breaking, the sun is apt to be denied access to dry them until the mosquito broods are on the wing. The ultimate effects are, of course, good. Here again dense cover crops are bad—sugar cane is unhealthy and bananas as already mentioned. On the other hand, crops like tobacco, demanding careful irrigation and the avoidance of stagnant water, do good.

(h) WATER FURROW.

I have reserved a special section for this possibly greatest, yet the most avoidable, cause of malaria on a South African farm. In order to get it as near the house, and as high up as possible, the fall given to the furrow is too small, and this alone leads to stagnation. But when to this is added the fact that it is only cleaned, in too many instances, when it gets choked and the water refuses to run, it becomes a very death-trap. For it is among the little tufts of grass along the edges that the stagnating water stagnates still further and forms ideal breeding holes.

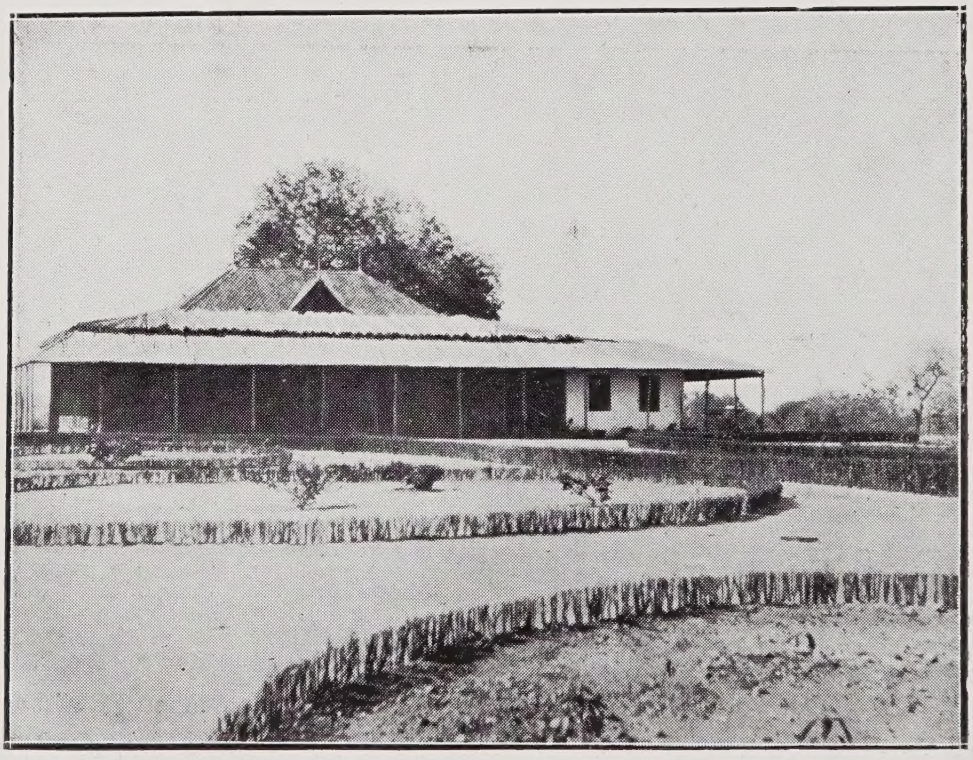

FIG. 8.

A good and cheap type of house for malarial districts. Note careful attention to grounds in front. Verandah mosquito-proofed.

In these circumstances the rule is—KEEP YOUR HOUSE, IN ALL POSSIBLY MALARIOUS SITUATIONS, AS FAR ABOVE THE FURROW AS YOU CONVENIENTLY CAN. HAVING DONE THIS, KEEP THE FURROW CLEANED AND TRIMMED. But in planning a new furrow give it as great a fall as possible and thus attempt to obviate the tendency to stagnation.

A colleague of mine attends a family who live in an ideal situation. Yet member after member of the family went down with fever. The doctor drew the attention of the farmer to his water furrow, but the old gentleman resented the insinuation as a sort of personal insult. Another case occurred.

Nothing daunted, the doctor took the farmer hunting for young mosquitoes in the water furrow—myriads were found, and by comparison with pictures the farmer was convinced. The furrow was cleaned and has since been kept clean. There has been no more malaria in the household.

Lastly, do not forget the dam. Keep its edges trimmed and stock it with fish—a few small fish from the nearest river will be your most trusty allies in keeping the dam clear of young mosquitoes. (See note concerning carp, page 13.)

(i) Bush Country.

The treatment of bush country follows very largely the principles outlined in dealing with trees. Thus the bush is

Fig. 9.

Cheap protection for a beginner. Built of wattle and daub, verandah, windows and ventilating space between wall and roof all mosquito proofed, cement floors. Cost about £5. Bush cleared.

cleared all round the homestead, preferably a square of about four hundred yards. Within this a few big trees may be left, but the smaller bush and scrub are all cut away. Next the grass is mown or cut, or burned if in winter. The enclosure can now be turned into a paddock and the vegetation kept under by stock. The laying out of the homestead, the site being cleared, can now be proceeded with on the advised principles.

Classed with bush country is what may be more properly called scrub country; where the grass grows rank and intermingled with it here and there are a few bush-like trees, but with a far larger number of shrubs and bushes.

The Police Post at Sibasa is placed in a country carrying just such vegetation, yet it may be described as a healthy camp, notwithstanding that this class of country carries much fever, and that the men patrol to the Portuguese and Rhodesian borders. Each year, they spend many nights in the valley of the Limpopo River, among the Malala palms and brilliantly coloured fever trees, which indicate with certainty the possibility of contracting fever of a virulent type and difficult to get rid of. How do they escape? They have learned the use of the mosquito net and invariably carry it with them. Thus they escape, whilst their police boys go down like ninepins.

The camp, however, it is that interests us in this place. It consists of a rectangle, say, about 1,000 yards by 400 yards. It is fenced in and occupies a gentle slope. Within the enclosure are the Native Commissioner's residence, offices, and staff quarters, as also the Police quarters and offices. The houses are mosquito-proofed, or have mosquito-proof doors. The scrub was in the first instance cut and cleared. The enclosure now serves as grazing for the Government transport and the private transport of the officials—as a result the grass is now getting short; there is no shade and no cover for mosquitoes; the sun penetrates everywhere, and any puddles which form are quickly dissipated by its heat.

But as a reverse to this picture, I can show you the store and residence of a prosperous trader. The soil and vegetation are the same. Yet it is a notorious fever place, and no wonder! The scrub grows right up to the doors, and trees still further obscure the light and exclude the air. Yet behind the store is a beautiful slope, which could with ease be cut and paddocked. But the transport animals of the trader are grazed in an enclosure at some distance, and the good they do, in taming the veld, is therefore lost to their own and his family.

At Sibasa, the houses stand right in the paddock without any enclosure of their own, except in one or two cases a small garden, but the farmer can easily arrange a subsidiary enclosure if the presence of animals right up to the doors proves too objectionable.

(j) Vleis and Pools.

These require somewhat extended notice, as amongst the choicest breeding grounds. Vleis can best be tackled in the winter season. There are two methods of dealing with them—either drain and cultivate, when they richly repay all labour

expended on them, or attempt to dry them up by tree planting. Certain species of Eucalyptus drain an enormous amount of water from the soil, and these properly utilised will materially help in drying up the vlei.

Amongst pools, I particularly direct attention to those made by man. The pit from which ant-heap or dagga is taken is too often left as it was used, only at the first rains to become full of water and an excellent mosquito nursery.

After the first rainfall, search should be made for any natural and shallow basins round the homestead, which are now easily located by being full of water. A few barrowfuls of soil, or possibly a small drain, should be sufficient to dispose of all danger from these sources.

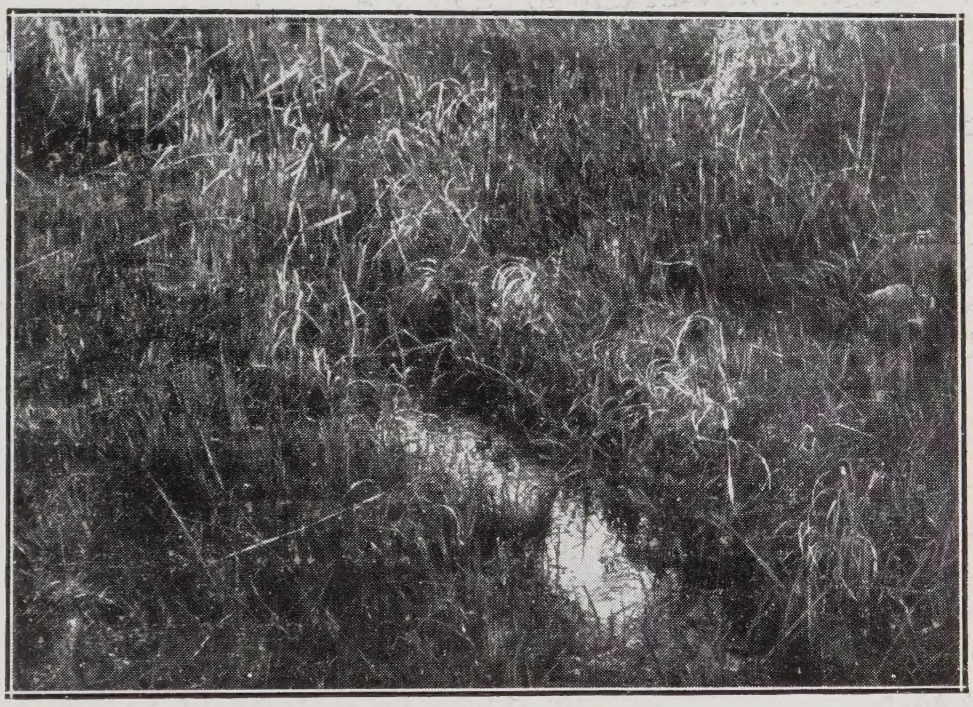

FIG. 10.

A stagnant water furrow breeding myriads of mosquitoes. A house is not far off.

The solitary pool, disconnected with the river, is possibly as difficult a problem as any. As suggested, it might be stocked with fish, or if these cannot be procured, it might gradually be filled up with refuse as opportunity offers.

There is one hint I wish to give with regard to vleis and pools. It is that frequently they seem to be formed by narrow outcrops of rock. The use of dynamite is now part of the farmer's handicraft. When time permits an effort should be made to drain any of these which prove difficult by other methods, by blasting a cutting in any definite rocky barrier that may be exposed.

Good frequently comes from screening vleis and pools. By this I mean planting a few rows of gum trees near the vlei or pool and between it and the homestead. These break the force of the wind, which aids the insects so greatly in their flights and filters them out so that they become an easier prey to their enemies.

(k) THE HOUSE.

However humble the home may be, there are three principles which should as far as possible be kept in mind in building and designing it.

IN THE FIRST INSTANCE, STRIVE TO MAKE IT SUCH THAT ONLY THROUGH THE NATURAL OPENINGS—DOORS AND WINDOWS—CAN MOSQUITOES ENTER. All other parts should be insect-proof. A few pence will buy mosquito gauze sufficient to cover a window and thus ventilate a bedroom. When circumstances permit, the gauze can be extended to other parts—doors, windows and stoep.

MAKE THE WINDOWS AS LARGE AS POSSIBLE. By this means a good light is secured, and this our silent friend abhors.

SEE THAT THE USUAL WALL VENTILATORS ARE FITTED WITH GAUZE ON THE INSIDE BEFORE BEING BUILT INTO THE WALL. In the evenings when the lights are turned on and the blinds pulled down the mosquito invariably is attracted by the thin streaks of light radiating from the openwork ventilators, in the inner recesses of which also the mosquito finds sanctuary in the day-time.

PLAN THE DWELLING ALSO WITH AN EYE TO THE USE OF THE WHITEWASH BRUSH, AND USE IT FREELY, and as often as opportunity offers.

By these means we bar the entry of mosquitoes except through openings over which we have control. By these means again we make our house as distasteful to our insect friend as possible. Should he enter, he will probably elect to leave, since inside there will be little to his taste. Outside he has many enemies, and the chances are he may not re-enter. For myself, I love to see his arch-enemies, the lizards, playing on the sunny gables; these little reptiles do no harm, but, on the contrary, must do good.

If we plan with a view to the use of the whitewash brush over, if possible, the entire interior surface, we have at our command a powerful aid in the prevention of infection.

With windows as large as possible, with whitewash always clean and fresh, any mosquitoes which pass our lines of defence can be more easily seen and destroyed.

But we still have a means of offence at our disposal, and that a powerful one—"spring-cleaning." Periodically wash

out, dust, brush, and whitewash—disturb everything, and thereby dislodge or destroy any insects that may have found refuge in the house.

In this connection, I call to memory the house of a friend who, with his family, suffers greatly from fever every summer. He is his own architect, and his own builder; he has planned his home on a somewhat ambitious scale, and has sacrificed his ceiling in order to secure a larger house. Thus the ventilation under the eaves is quite uncontrolled, and the right of entry entirely at the caprice of our silent friend. Inside, he has

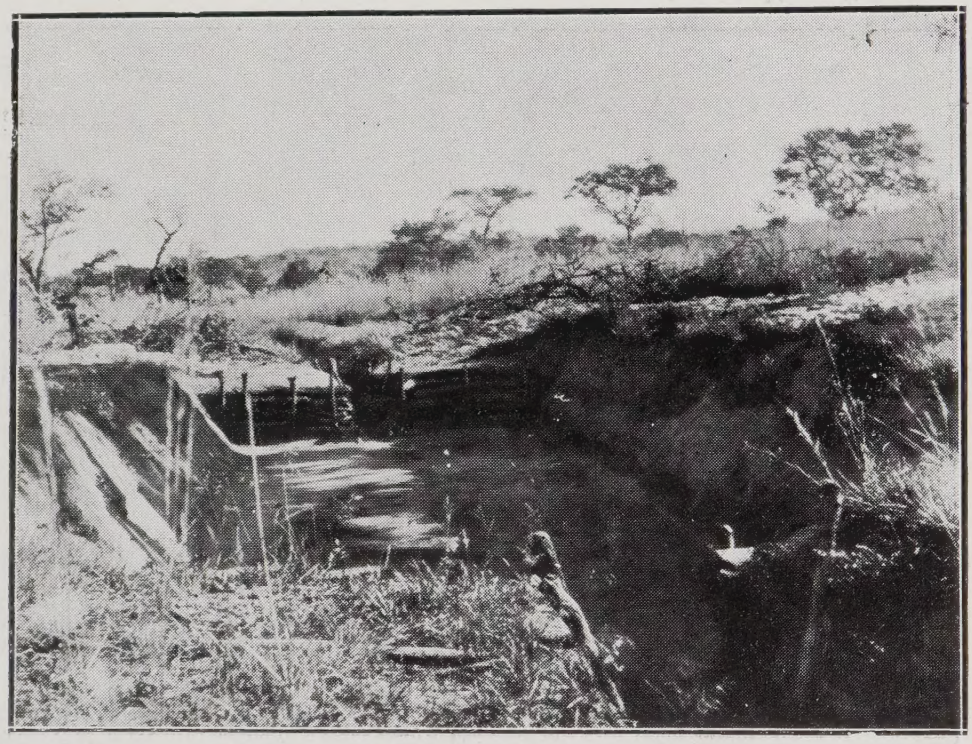

FIG. 11.
A solitary pool—ideal breeding place.

chosen as sleeping quarters a bedroom with two small chambers leading into one another—an excellent arrangement but for one thing—that he has quite forgotten his windows and the place is nearly dark.

What happens is obvious. Mosquitoes have uncontrolled entry—when inside there are many dark and cosy corners exactly to their liking. In these they lurk, and if not already carrying the infection soon get the opportunity and acquire it. Once some member of the family becomes infected, all the mosquitoes in the house have access to the reservoir, and soon every member of the family has become infected.

Had my friend followed our principles, in the first instance, no fever mosquitoes could enter, since the space under the eaves

would have been closed and the house ceiled, even if he had to make the house smaller. Those insects, which eventually entered, would have found the light and the whitewash extremely distasteful to them; some might be seen and killed, others would be disturbed or destroyed in periodical spring-cleaning.

(3) THE VICTIM.

What to Avoid.

I mentioned under the heading "*Peculiarities*" that the germs of malaria could remain in the system without producing

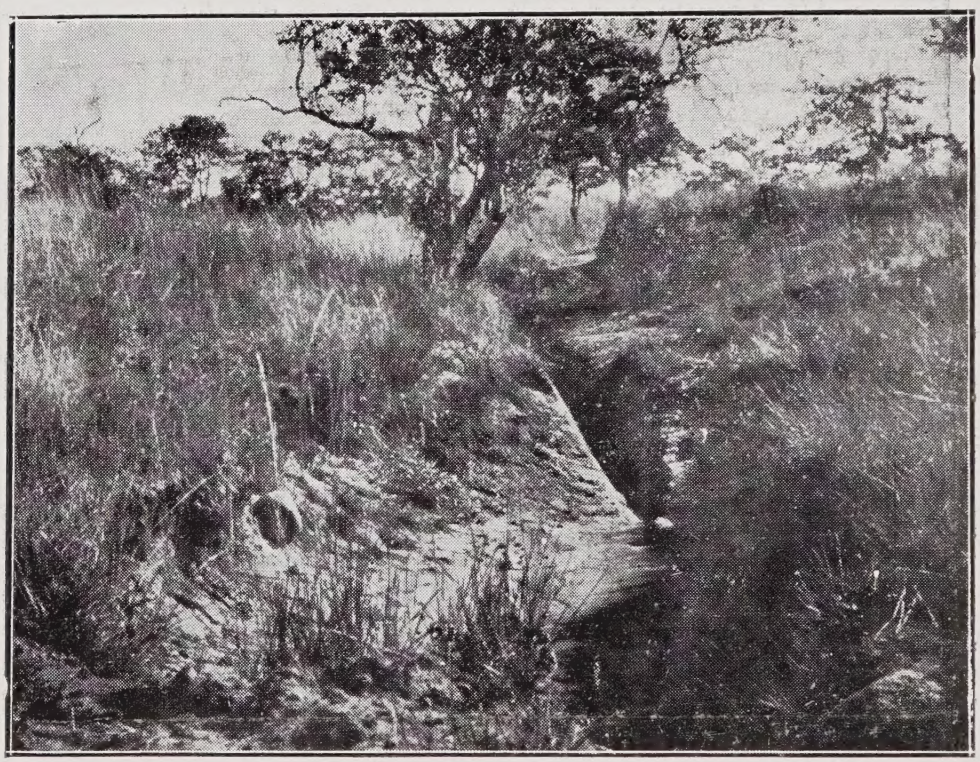

FIG. 12.
Note pool drained by cheapest form of ditch—V-shaped.

obvious ill-effects under two circumstances (1) when the individual has never had a definite attack of malaria, and (2) when an attack of malaria has not been effectively treated. Now, I believe, and many other doctors believe, that if a person so infected keeps himself in good health, his system often manages to kill off the germs, and thus prevents an attack. Therefore the settler can help himself to a large extent by careful attention to his health—moderation in eating and drinking, plenty of vegetables easily and cheaply grown, and the avoidance of some causes which seem specially to operate as a cause of attacks of malaria.

Chief among the latter is too great exposure to the heat of the sun. I am aware that it is impossible to do without

working in the sun, but the work could be so arranged that the hottest hours are passed indoors, and the effects can be further lessened by the use of a suitable helmet. Many good makes are now on the market; makes which come well down over the neck and protect the temples. Choose one as thick as possible—it gives most protection. A helmet is a cheap headgear, but its efficacy in warding off relapses of malaria is undoubted by anyone of experience.

The newcomer is apt to indulge in river bathing, and it is possibly the best inducement he can offer to infection or relapse. If early in the morning or in the evening, mosquitoes may be active. If between these extremes, then it necessitates exposure of the uncovered body to the heat of the sun.

Chills and wettings are fruitful sources of relapses. The former are frequently accounted for by the exposed situation of the homestead. As I have already said, some way up the hill is the best place; it is when placed too high up that cold winds and draughts are complained of.

It is, of course, impossible to avoid a wetting now and then, as when caught in a storm, but the most fruitful source of relapses that I know of is the wetting caused by long grass being allowed to grow right up to the doors of the house, and from trees planted too close together that one cannot pass between them without touching the foliage. Plan to keep your grass short and trim the lower branches of your trees.

Another source of relapse is a rapid change from heat to cold. Sometimes the sun seems to sink with extra rapidity, a cold wind rises or a mist comes up, and one feels chilled to the bone. The remedy for this is the use of woollen undergarments to equalise the surface temperature of the body. No one should start work in a malarial district without a full set of such clothes; they are to the body what the helmet is to the head.

These conditions are what I referred to when I spoke of aggravating causes.

Rapid changes of altitude have an extraordinary effect in bringing out latent malaria. Many men have tried living on high ground and coming and going to their work on the low-lying ground morning and evening. The effects have been disastrous where the difference in height has been in any way considerable.

It seems difficult for the new-comer to understand this. The tops of the mountains are free from malaria, and it seems at first sight reasonable to suppose that a home in a healthy place would beneficially affect workers even if their work takes them to an unhealthy locality.

An example of this peculiarity, on a somewhat larger scale, has occurred in this district. Shortly after the war, police posts were established throughout the district. On the supposition that the men's homes should be in as healthy a position as possible, these posts were established on the Zoutpansberg Mountains, but in all cases the men had to patrol the flats. The results were disastrous; after every patrol the men went regularly down with fever. All these posts were eventually disestablished and the men stationed on the flats. The benefit to health has been extraordinary, although the men are apparently exposed to the infection day after day instead of only when on patrol, say, a day or two in the week.

Drugs.

The new-comer frequently carries an elaborate outfit, but my remarks are concerned with only two drugs, or rather with one class and one drug.

The class of drug to which I refer is the aperient class. And with regard to this, the settler must at the outset remember that they are more necessary in the hot districts than in cold places, and more required in summer than in winter. Whilst best taken in moderation, too much is certainly better than too little. The aperient will, of course, vary with the individual, but generally it may be said that the most suitable is the one to which you have previously been accustomed (since you have probably by experience found it most satisfactory), only you may now take it in larger quantity and more frequently than before.

The drug to which I referred was quinine. This drug is of course the most efficacious cure for malaria, but here we are concerned with its use as a preventative of the disease.

Quinine may be administered (1) by the mouth, (2) by the use of a hypodermic syringe. In either case the object is to keep a small quantity circulating in the blood in order to destroy, or attempt to destroy, the organisms of malaria as soon as they are introduced into the system.

In taking quinine, however, it must never be forgotten that it is a powerful drug—foreign to the system, in fact a poison in excessive quantities. In some persons it readily gives rise to disagreeable symptoms, which are really the effects of the drug acting as a poison. Such symptoms are many—among others indigestion, skin rashes, headaches, dizziness. For such I think the best advice one can give is to discontinue the drug, and attempt its use only when necessary for the treatment of an attack. The use of quinine as a preventative should also be confined to the months of the year when malaria may be contracted. Further, it is well to remember that quinine

is best borne and most readily absorbed when the digestive system is in good order—hence again the great value of aperients.

The dose of quinine as prescribed usually varies from 5 grains to 15 grains at a time. As a preventative it may be taken each day—say 5 grains each morning, or it may be taken as 15 grains each 8 days, say every Sunday. A number of men take the drug only when they think they are to be specially exposed to infection—thus on a journey into lower veld, they take the drug before they go, while they are away, and for two or three days after their return, and claim excellent results.

The administration of quinine by hypodermic injection requires the services of a medical man, but, for those who can manage it, it is an excellent method of administration. By it, a quantity of quinine can quickly and almost painlessly be placed deeply among the muscles, whence it becomes slowly absorbed and circulates through the system. I know many men who have themselves inoculated each summer and are enthusiastic over the result.

Quinine is most conveniently stocked in the form of tablets; in this condition it keeps well and the dosage is accurate. There was formerly a prejudice against tablets, but now their manufacture has been so much improved that they are very efficient indeed. Buy them, however, uncoated (plain) and see that they are of a reputable make. For practical purposes there seems little to choose between the various forms of quinine offered by the chemists. I think, however, the bi-hydrochloride is the best, with the bi-sulphate following it very closely.

Special Danger at Night.

New-comers, especially, should remember that mosquitoes bite, as we have seen, most frequently at night. Accordingly, as often as feasible, they should remain indoors from sunset to a little after sunrise. If on a journey, they should try to make some shelter each night, and in the summer time avoid sleeping in native kraals. Portable mosquito nets, cheap and handy, are now sold; if one has much travelling, such a net should find a permanent place in the luggage for use, especially in dangerous places.

IV. SIDE-LIGHTS.

How to Tell Malarious Country.

I am frequently asked by prospective buyers if such and such a farm is malarious, and I have found my position, in such a case, most unsatisfactory. If the purchaser has decided to buy, my advice usually makes no difference; if hesitating, he makes use of my advice to call off the bargain, and leaves me to settle with the would-be seller who accuses me of spoiling his sale. Now, therefore, I advise my questioners to use their eyes and study the vegetation; not such as occurs in sheltered cosy corners or in frosty pockets, but such as they find growing on the open veld, which constitutes the bulk of the farm. Cold is after all the enemy of the mosquito; if plants which abhor cold and are injured by frost are found growing luxuriantly. then the farm must be potentially malarious. Our proper fever veld here is distinguished by the baobab (cream of tartar), by the mapani, and by the "fever tree," with its brilliant but deadly-looking green stem. But inside these extremes consider that frost easily injures citrus trees, that the banana is cut down, and guavas make no headway. Look through the orchard and round the native stadts and see what trees are present. Note if the pawpaw and mango are there. In fact, use your eyes and convince yourself.

Unoccupied Houses.

In taking up a farm. one of the inducements offered is very frequently an old disused house or two. These should be very carefully avoided. As we have said, mosquitoes frequently hibernate and settle in such places, and as soon as disturbed, proceed to bite the newcomers. I have known many such cases occur. I have warned many people, but often the lure of a ready-made home, if only a temporary one, has been too strong; my advice has been disregarded, with evil consequences. In such a case it is best to camp in the open veld, using the house not for sleeping quarters but as a store-house and for implements and stock, unless you are prepared to thoroughly cleanse, aerate and disinfect it, and, lastly, do not forget to remove all vegetation around it.

A Piece of Advice.

I would say to every prospective settler: Make friends with your doctor. Give him your confidence in these matters

and get his advice. At a recent sitting of a Circuit Court, six men dined by chance together in the local hotel. Of these five were doctors from the district; the sixth was a farmer. The chief topic of conversation was the relative proportion of dead to live weight in the various breeds of cattle, sheep and pigs. This story sufficiently indicates that the interest of the profession is with the man on the land. Make him, therefore, your adviser in these matters; he will feel flattered by your confidence, and will very gladly place all his experience at your disposal.

Identification of Mosquitoes.

I have purposely treated the life history of the mosquito and the parasite of malaria at some length, because I think that I can best secure the reader's attention and convince him of the truth of the theory, if, so far as I can, I make things as clear as possible to him. But there rests with himself a better way of securing complete conviction, and that is to do a little nature study for himself. If he can find, as opportunity offers, two distinct species of mosquito, if he can find differences among the young broods in the water, I feel certain that it will increase his interest in the subject, and secure a more favourable judgment of our views. Accordingly, I have added in the appendix so as not to overload the text, a classified description of the two perhaps commonest mosquitoes.

I would here say that it is no use looking for mosquitoes if you seek yet do not wish to find. Many people will not admit that they have any mosquitoes, or if they do admit, say they have only those that "sing."

Not so long ago, I was visiting at a farm house. Suddenly from a disused matchbox my hostess produced for my inspection, an insect which was most certainly a malaria-carrying mosquito (and I am afraid she knew it), saying at the same time in a tone of intense anxiety, "This is a gnat, isn't it?" I now knew that the house contained malaria-carrying mosquitoes, and that should they become infected—say from some native servant or chance visitor—one or more cases of malaria would occur in the household. What I should have said was, "Madam, this is certainly a gnat, but a gnat is only another name for a mosquito. I regret further, to have to add that this is a specimen of the malaria-carrying variety. I advise you not to allow your son to sleep on that unenclosed verandah any more, and to thoroughly spring-clean your house—fumigate if you can manage it—and give some attention to the vegetation around your dwelling." But man is in certain circumstances frail, and this was surely a case in which she who sought desired not to find, so I merely answered in my weak-

ness, "Yes, indeed, it is a gnat." But a few weeks later, my conscience gave me many a twinge, for the little son of the house went down with an attack of malaria. Was I, or was I not, morally responsible for that youngster's week of fever and weeks of tardy convalescence? To be sure I had not told a lie, but I had been guilty of deceit since I had told but half the truth. The moral of the tale is obvious—in studying mosquitoes look the facts in the face, and let not the wish be father to the decision.

Mosquito-Swatting.

We have had recently in many lands campaigns for the destruction of flies under the names of "Fly-Killing" and "Fly-Swatting" campaigns. Why should not we in the Low Veld have "Mosquito-Swatting" campaigns, making it our object especially to kill all mosquitoes in and around our dwellings? In particular we should make it our duty to kill all mosquitoes found in our living rooms.

Details of how to proceed in killing mosquitoes in the various stages of their existence will be found in other publications issued by the Association.

When to enter and when to leave Malarious Country.

Country residents say that malaria stops after the first frost, and this is very generally true—except that new infection stops when the weather becomes cold, even if frost has not actually occurred. The question then is, when does this occur? In our district we put it at about the 15th of May, but generally it may be said a safe and fairly general time would be, to be definite, the first of June. As early after this as possible then the settler should occupy his new holding, so as to build his home and clear his immediate surroundings before the summer sets in too hot.

We have also said that cold and altitude may bring out fever —often an attack which would not otherwise have developed. Cold and altitude go together, hence when you take your annual holiday take it before winter sets in definitely on the high veld, and if possible, spend a few days, if you are not spending your entire holiday, in some place at an intermediate altitude.

Mosquito Nets.

The mosquito net has played a large part in the prevention of malaria. It may be had large enough to hang over a double bed, or small enough to carry anywhere in your luggage. It is now so cheap as to be within the reach of every settler. Use it particularly when you suspect you are sleeping near infected persons. It is a useful help to a pleasant existence in the low

veld. It serves, for instance, very usefully to keep flies from worrying when you are resting.

IN USING A NET FOR MOSQUITO PREVENTION, SEE THAT THE MESH IS FINE ENOUGH TO EXCLUDE MOSQUITOES, THAT IT IS WITHOUT HOLES OR TEARS, AND THAT IT IS SO ARRANGED THAT IT CAN BE COMPLETELY TUCKED UNDER THE MATTRESS SO AS TO EXCLUDE INSECTS FROM BELOW. The Scotch say, "Early to bed, early to rise, makes a man healthy, wealthy and wise."

FIG. 13.

A good screened verandah—note protection for gauze below level of hand rail.

This is not a bad rule for a well-regulated home in the low veld. In using the net, the first part of the proverb is the most important. Get under the net so soon as you possibly can, since mosquitoes are very active in the early hours of the night. Further, stretch the net tight—by this means you get better circulation of air, and do not feel so "stuffy." I would emphasise that the insects if hungry will search for a hole in the net to get at their victims, hence a small hole may obviate the usefulness of an otherwise perfect net.

Mosquito Wire Gauze.

In erecting wire gauze, do not forget to protect the lower two feet or so with slats or by other means. This part always gets damaged, say by the feet of human beings; once a small hole is made, it soon becomes enlarged by cats and dogs or by children playing. I stayed at an hotel not very long ago; the proprietor had a gauze lined stoep of which he was very proud, likewise a prize dog. But it was quite amusing to see the dog jumping through a hole in the gauze near the bottom of the door, where someone had evidently at some time thrust the toe of his boot through.

In erecting gauze, do not forget the part between the top plate and iron. These corrugations can be easily closed by waste, clay, or other material.

Lastly, do not forget to look to the gauze frequently and keep it in repair, thus preventing any holes made getting bigger.

Blackwater Fever.

No account of malaria or malaria prevention can be considered complete without some remarks on a disease which occurs in the same situations and at the same times as malaria —blackwater fever. For many years it was considered that this disease was only a sequel of malaria—bad malaria, often repeated—or, by other authorities, that it was brought on by quinine. Both these theories are to-day largely abandoned, and blackwater is looked on as a separate disease, occurring along with malaria only because the conditions which are necessary for the development of the one are the conditions required for the development of the other. It is certainly not due to quinine, because it occurs in epidemics among Central African natives who, of course, take no quinine. It cannot be due to malaria, since it has occurred in epidemics in institutions such as lying-in hospitals, the inmates of which hardly suffer from malaria!

But what interests us most on the farm is that it is now supposed to be due to a similar organism to that which causes red water (Texas Fever) in cattle. It is further interesting to read of an epidemic in a high-lying district, which is supposed to be due to the conveyance of infected parasitic insects by imported cattle.

And this theory makes one pause and think. Undoubtedly one of the perils of the low veld up to the present—of what may be called the lower low veld—has been this terrifying disease. Does this theory, and latest discoveries, extend to us hopes of a better day? Does it mean that, when, by universal dipping, ticks and cattle parasites will have disappeared, this

dread disease will be banished from the list of South African maladies? And yet it well may be that when the Hon. Joseph Baynes built his dipping tank, he took, all unknown to himself, the first step towards the eradication of this, the scourge and terror of the low veld.

Horse-Sickness and Malaria.

The Union Department of Agriculture have for the year 1915 a sum of money on the estimates to defray the expense of a mosquito survey, since it is believed that among these insects will be found the carrier of horse-sickness.

It is interesting, however, to remember that long before

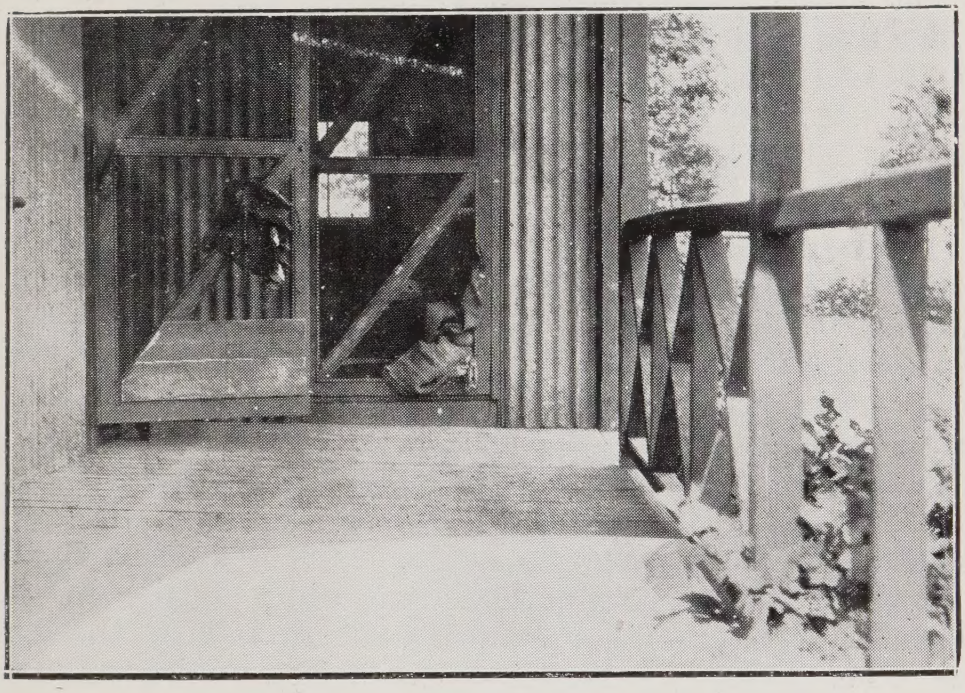

FIG. 14.

Example more powerful than precept—mosquito netting on a Government building. Note grain bags and clothes thrust through holes in gauze, leaving gaps through which mosquitoes can enter.

the advent of scientific agriculture to South Africa, many of our old-time farmers accepted the theory of the transmission of horse-sickness by some flying insect. Indeed, it is possible that this theory was held even before mosquitoes had definitely been associated with any disease. It is true that the dew and the mist-rain were in many instances thought capable of causing the disease. But, on the other hand, we hear of, and know of, manure smudges being burnt to keep insects away, we have seen garlic inserted under the skin of the neck of the horse with the idea that in its excretion it would drive insects away; asafoetida (Duivel's Drek) has been drunk for a similar pur-

pose; whilst the muzzle and sometimes even the whole body have been smeared with paraffin.

Years ago farmers in this district were, in my experience, taking asafoetida themselves, regularly, in order to drive away mosquitoes on its excretion by the skin, and so prevent malaria. Horse-sickness and malaria appear in the same places and at the same times. Generally when one is bad the other is so also.

Farmers noted that horses "salted" from horse-sickness in one district and did not acquire the disease again in a severe form. Natives, as we have seen, brought up in a malarious district, acquire an immunity. Horses salted in one district were not salted for perhaps the neighbouring district. Similarly, we find that natives acquiring an immunity on the slopes of the Magatoberg go down badly with fever when taken on patrol to, say, the Portuguese border.

Ranching.

There is a tradition in the Spelonken that after the rinderpest malaria increased for a time, both in severity and frequency. The rinderpest passed over the district about 1897, destroying both game and cattle. This observation is supported by the experience of other countries where the method used is virtually to tame the veld by means of cattle run on large areas of ground. In short, in America, Australia, and now in Rhodesia, the land is reclaimed for settlement by the taming influences of stock. Cattle, for example, do well in hot countries, which, given moisture, are very malarious. They can be run for beef production most economically in large batches. Hence capital becomes associated with the enterprise. The ranch is fenced into paddocks, which are systematically grazed; proper water supplies are found, and some drainage done; the employees are well housed and fed. Gradually, therefore, at a minimum of human suffering, the veld is so far tamed that the settlement of Europeans can be successfully accomplished. In other words, the small man succeeds the company, when in due course capital and stock have reclaimed the veld.

Government and Corporations.

Large tracts of country still remain in the hands of Government and of large land companies. In what manner can these best assist settlement? In the first instance, large tracts of country now unoccupied to a great extent by either whites or natives, are the undisturbed haunt of the mosquito. These could best be tackled by a policy encouraging ranches.

On the other hand, from the nature of the country, from their water supply, from the richness of the soil, from their

contiguity to railway or market, certain parts offer inducements to smaller farmers. In these cases, much could be effected by a careful survey of unsurveyed ground or a careful sub-division of farms with an eye to malarial prevention. To illustrate my point, suppose, as frequently happens, a block of holdings abuts on a slow flowing river opening out here and there into vleis. To prevent malaria this has to be reclaimed, drained and cultivated. The task would be altogether too much for one man, supposing a large portion was cut into a single holding. But

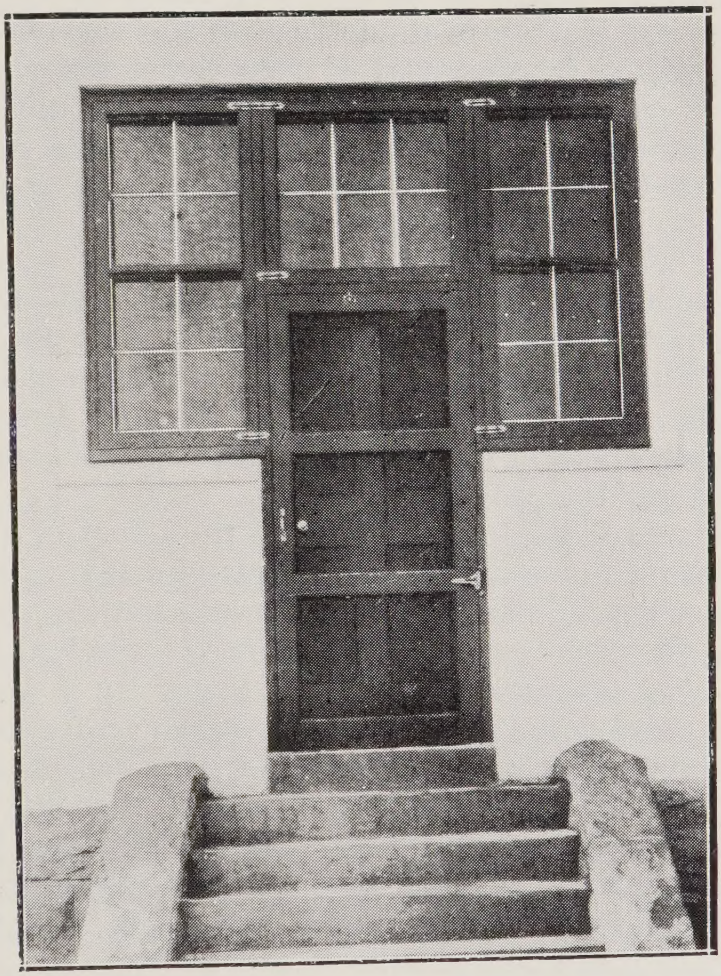

FIG. 15.

A good type of screened door and windows—can be modified to suit requirements—note spring catch to door.

suppose the holding ran across this vlei; then each man has a portion which he is able to reclaim, and thus by united action a result could be effected altogether beyond the power of the individual.

But in larger cases, it might still be impossible even for a number of farmers. In these instances Government or a corporation should undertake reclamation before allotment. The rich soil of the vlei, under irrigation, and extremely valuable from the quantity of organic matter therein, warrants a very large expenditure for reclamation.

Villages.

We have previously seen how in townships, malaria tends to die out, and it may not be out of place to indicate how, in laying out new villages or in planning closer settlements this result can be hastened. Take, for instance, the village of Louis Trichardt, itself only a type of many. Out of 1.500 erven, only some 300 are occupied, and these are scattered over the entire township. Aside from malaria prevention, consider the expense to the Health Committee to conduct a sanitary service and lead water over an area five times as large as necessary. Were some attempt made to stop speculation, and erven were only granted for purposes of occupation and contiguous to those already occupied, a compact settlement would be secured, which would be thoroughly cleared, drained, and improved, to the very great benefit of the health of the community.

Every little helps.

Many people think that to produce any results in malaria prevention, a whole district must be tackled in its entirety at one time. But this is not so. Every measure taken reduces the total amount of malaria, meaning thereby the number of actual cases of persons harbouring the disease, and of mosquitoes carrying the infection.

To understand my meaning, take the effect of the inoculation of mules on horse-sickness or kindred disease. One season horse-sickness was so bad that I had to use nothing but donkeys to get round the country, since no horse or mule had any chance of surviving the summer. Mules are generally more numerous than horses, and hence act as the reservoir of the infection. Since inoculation has been undertaken, this reservoir has been very largely diminished, and the result is that horse-sickness has become much less frequent. We still have horses, we still have mosquitoes, we still have their breeding grounds; but the source of the disease having become less, the number of cases have still more decreased.

Epidemics.

Epidemics are frequently very disconcerting things. A disease seems to have stopped, and has not been known for some years, when suddenly it appears and affects everyone. The epidemic is a natural phenomenon—it occurs in connection with all disease. It is therefore to be expected in malaria, and does not mean that our premises or means of prevention have been wrong. But we know as we proceed with our work that the epidemic will also get less in frequency and less in severity.

V. THE LESSON—APPLICATION—PRINCIPLES—IMPORTANCE.

The Application of the Lesson.

I spoke in the early part of this essay of a Mission Station. To drive home the lessons I have been teaching, I propose to give a pen picture of this station. I do so because it really exists, and I am, therefore, able to convince any doubting Thomas by confronting him with the original. It proves conclusively what care and experience can effect in the subjugation of malaria. Moreover, the home is a simple dwelling, such as is well within the ambition of the ordinary settler.

The house, then, occupies the face of a hill—not the summit. It is well removed from a sluggish river and vlei, screened with trees. The native stadt, the reservoir of infection, is placed well on one side. The water-furrow comes far below the house, and is carefully attended to. The soil is gravel, which does not puddle with rain. The view in front is uninterrupted, the trees are scattered far apart at the sides and back, allowing free access of sun, light and air. The banana grove is not conspicuous, occupying, as it does, a hollow at a little distance. Lastly, the grass around the house is short and sweet, for on it the station mules are encouraged to graze.

As a result, the family, including even the children, enjoy good health the year round. For be it remembered the security he enjoys is the result of experience; an experience for which his predecssors paid dearly. Why should not we also profit by their sacrifices?

Contrast, on the other hand, the trader, choosing for business purposes a site occupying a triangle between two rivers and a vlei. He barely maintains his family healthy in a mosquito-proof specially-built house, with a long yearly change of several months.

The Principles of the Lesson.

But what does all this amount to? Merely that we put the reservoir of infection on one side, and get as far as possible from the haunts of the carriers of that infection on the other. Having done this, we call in our glorious South African sun

to do the rest. It is true that we choose a suitable slope and soil; that we call on our animals to keep the grass short; that we plant our trees so that the sun can always penetrate between; but all the time we are relying on nature and by working with her, encourage her to work for our good. In other words, we strive, with the aid of nature, to make our surroundings as distasteful to mosquitoes as it is possible to make them.

Even in planning and designing our house, we never for a moment forget that nature works by sun and light; we use light colours and build our windows as large as our circumstances permit. In order to afford us shelter we have necessarily to shut out nature's great cleansers—the wind and the rain. Here again we imitate nature and decide to employ frequent cleansings and whitewashings. In ourselves also we have learned that certain causes tend to bring out attacks of fever, and these we avoid; we agree to assist nature in throwing off infection by putting our bodies in proper condition; lastly we must never forget that nature grows for us the cinchona plant, from which we extract quinine to help us avoid infection and to cure the fever should we acquire it.

A Last Word.

Lest it may seem to the reader that with my banana groves, my park-like grass, and my arrangement of trees, I am writing for the owner of a mansion rather than for the struggling settler, I wish to make an explanation.

I have for many years been the interested spectator of attempts, successful and unsuccessful, at settlement in a new district. And this is the conclusion I have come to: That the man who makes good is the man who, from the first, plans his operations with an eye to possible expansion in the future. The careful choice of a site, the grazing grounds, and the water-furrow properly made—all are as necessary to the cottage as the mansion. The planting of a few trees is the duty of everyone; their proper spacing costs no more than their careless planting. The far-seeing man plans his surroundings to suit the day when the commodious dwelling-house shall succeed the "shack."

Again, a commodious house should be the ambition of every settler and farmer. When he "makes good," in a hot malarious district, it can be appreciated at its full value, and it makes for a higher standard of health. But such a house is incomplete and apt to be a comparative failure—has indeed proved so in practice—unless the considerations I have mentioned receive due weight. Therefore, I ask the reader not to imagine that I in any way belittle mosquito-proof houses; on

the contrary, I am an enthusiast with regard to them, but this paper is written for the man who presently cannot afford them, to help and aid him in the maintenance of his health till his ship comes in.

The Importance of the Subject.

A very large part of the malarious districts of the Union is sparsely populated, and there is room for more settlers. Another very large slice is as yet unoccupied. It is important to us as a white race, outnumbered by a teeming native population, to fill up the vacant places and entrench our position. Nor are volunteers for the task wanting, only many fear the mysterious disease with which their first battle must be fought. Our forefathers gained many a notable victory and won rich country from mosquitoes and disease to the great benefit of posterity. These victories were gained without the aid of quinine to cure or any knowledge at all of the cause of the disease; with an adequate knowledge upon both these points, shall we shrink from their task?

But aside from high politics, dwellers in malarious parts have definite and important functions to fulfil in the economics of the Union. As time goes on, we find a daily growing industrial and urban population, and this apart from the inhabitants of mining centres. Workers in factories and workshops must very largely increase simultaneously with the establishment of manufacturing centres. For such, life is brightened and health maintained on a higher level by the provision of a cheap and abundant supply of fruit and vegetables all the year round. Where do we now get even the humble and necessary potato out of season? Whence comes our best oranges, naartjes, and lemons? Whence, again, the mango and the pawpaw? Is it not so that tomatoes at times reach famine prices?

Other countries keep up their supply of fruits and vegetables by an elaborate system of importation, supplemented by the produce of glass houses. In our country. the parts which the fever mosquito inhabits produces abundantly without glass houses or special appliances of any kind. The climate all over the Union demands for the maintenance of the health of the people a constant supply of fruits and vegetables. In ourselves we have no doubt that the Low Veld will be equal to its destiny, and that one of the charms and advantages of South African life will be an abundant supply of health-giving vegetables and luscious fruits at prices within the reach of even the poorest of the people.

VI. RECAPITULATION.

In the foregoing pages we have endeavoured—however imperfectly—to follow a definite scheme, and we would ask the reader, for the clearer understanding of the subject, to bear with us while we, in outline, recapitulate the main purposes of our various divisions.

I. In the "Foreword" we have treated of malaria as man found it in his experience—of its world-wide distribution, of the effects of colonisation upon its prevalence, of the result of scientific measures for its control, of the discovery of the cure of the disease itself by means of quinine.

II. In "Malaria—The Disease" a short description is given of its symptoms, effects, distribution, and immediate cause.

III. In the section, "Source—Carrier—Victim," we have indicated the source from which the disease arises, and have suggested how danger from this direction can be minimised. We have further detailed the life-history and habits of the carriers of the disease, and on this foundation have built up a system, the object of which is to render the carriers unable to reach their victims. With regard to these latter we have suggested means whereby they may best, by care of their health and the regulation of their habits, put themselves in a position to resist attacks of the disease.

IV. Under "Sidelights" we have gathered together a number of observations, which, whilst strictly not included in it, help us indirectly the better to understand our subject.

V. In "The Lesson—Application—Principles—Importance," we seek to drive home our lesson by a concrete example, to deduce principles from our practice, and endeavour to indicate a few points bearing on the importance of the subject.

VI. Recapitulation.

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APPENDIX I.

DIFFERENCES BETWEEN "SILENT" AND "SINGING" MOSQUITOES.

The following particulars are mainly copied from article by Mr. Jacobus C. Faure, published by the S.A. Anti-Malarial Association. For further information and further sketches depicting the life history of the Mosquito, see the wall card issued by the Association, the pamphlet by Mr. J. C. Faure, also the article by Messrs. Bostock and Simpson, in *Transvaal Agricultural Journal*, Vol. IV., page 562.

ANOPHELES.	CULEX.
A "silent" mosquito.	One species, very common, of "singing" mosquitoes."
Adults	*Adults.*
"Wings usually spotted. When at rest, body at an angle to surface of wall."	"Wings clear. When at rest, body parallel with or almost touching the wall."
Eggs.	*Eggs.*
"Laid singly in water."	"Floating in raft-like masses."
Larvae.	*Larvae.*
"Have no breathing tubes. Bodies parallel with surface of water when at rest."	"Have a long breathing tube at the end of the body. Hang, when at rest, with body at angle to surface of water."
Breeding Places.	*Breeding Places.*
"Usually earth ponds or edges of slow streams or ponds."	"Usually tanks, barrels, old tins, bottles and the like."

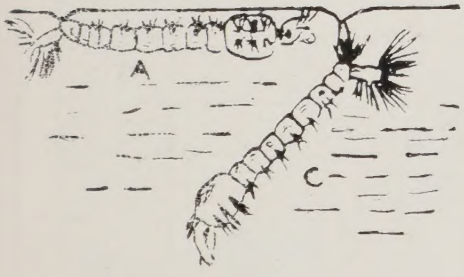


FIG. 16.

FIG. 16.—Resting position of mosquito larvæ. A. Anopheles. C. Culex.

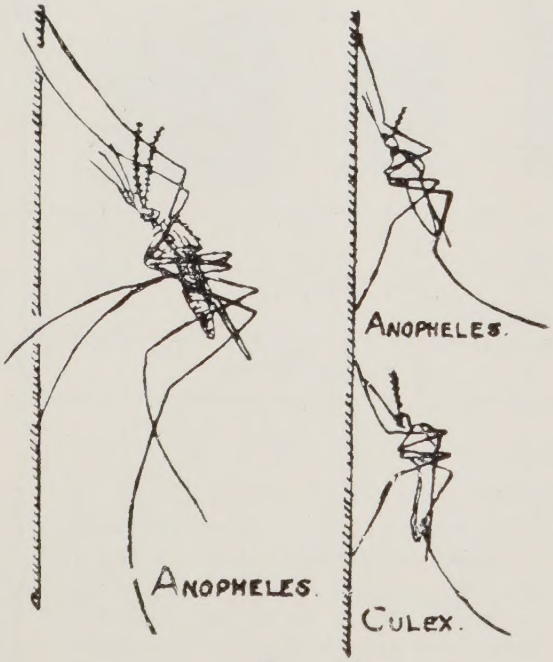


FIG. 17.

FIG. 17.—Resting position of adult mosquitoes, illustrating the differences mentioned above. See also Fig. 1 on page 9.

APPENDIX II.

MESH OF MOSQUITO NETS.

For information with regard to mosquito nets, their use, sizes and construction, see article in *Transvaal Agricultural Journal*, No. 21, Vol. VI., October, 1907, by Dr. F. Arnold, now Chief Medical Officer of Health for the Union of South Africa.

In gauging the mesh of a mosquito net, proceed as follows : Stretch the net over a sheet of paper, choose a row of holes in the net, through each hole make a pin mark in the paper, measure off 3 inches of this line, count the holes and divide by three. This gives the number of holes to the linear inch.

It is sometimes very confusing to count the holes direct from the net—this method obviates the difficulty.

In the paper above mentioned, Dr. Arnold describes experiments conducted by himself with four specimens of netting bought at random in Pretoria. I have measured the meshes, and, correlatively with Dr. Arnold's remarks, find :—

No. 1.	No. 2.	No. 3.	No. 4.
Good.	Doubtful.	Bad.	Very bad.
13	12	10	8

From these results it is obvious that the proper mesh is from $12\frac{1}{2}$ to 14—the latter being about ideal.

It is also obvious that there are a large number of useless (so far as mosquitoes are concerned) nets on the market.

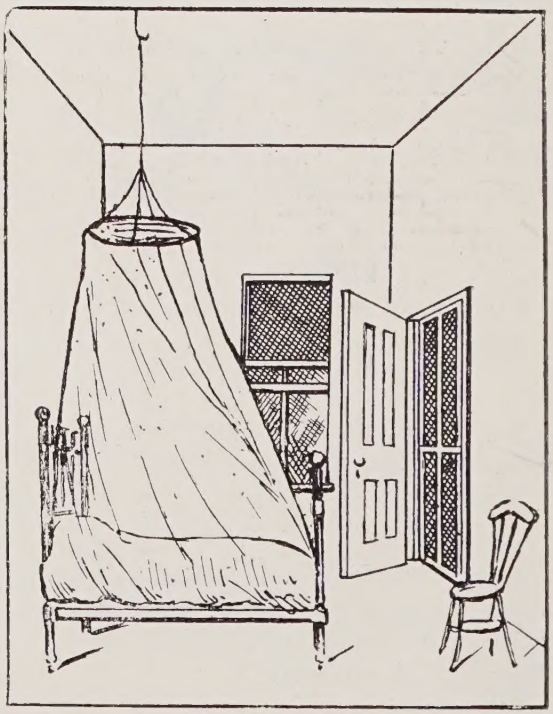


FIG. 18.

Sketch showing manner of use of mosquito net.

APPENDIX III.

MESH OF MOSQUITO WIRE GAUZE.

To count, proceed as for the mosquito netting. Owing to a difference of material, the mesh of gauze must be smaller than in the case of netting. By smaller—we mean, of course, that there are more holes to the linear inch. The proper size in gauze is 16 to 18 to the inch. It is recommended that the best only be used if procurable. Copper or brass wire is more expensive than galvanised or tinned iron, but it is more effective, since it lasts longer, and hence there is less tendency to get into disrepair, and become thus useless for the purposes for which it is intended.

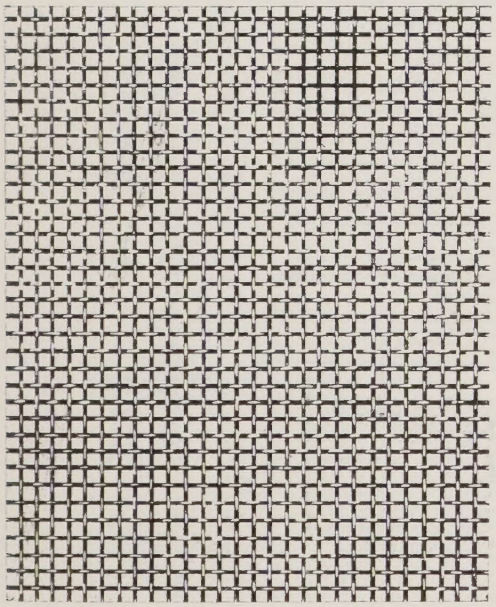


FIG. 19.

Shows proper mesh of wire gauze for protecting doors, windows, stoep, etc.

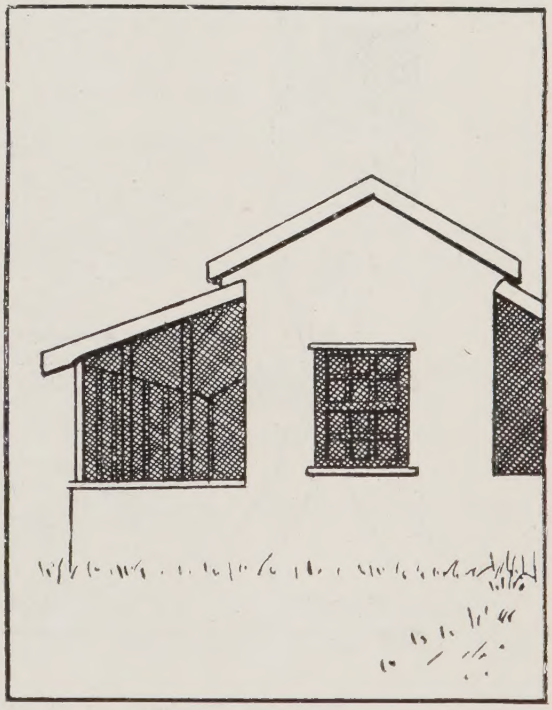


FIG. 20.

A house well protected with wire gauze so as to exclude mosquitoes, flies, and other disease-carrying insects, is not only a comfort—it is a sound investment, equivalent to an insurance against sickness.

VOOR HOLLANDSE LEZING, ZIE OMMEZIJDE.)

[Publication ... No. 6.]

Culex ... Female (greatly enlarged).

DANGER OF MOSQUITOES.

Culex Mosquito Male (greatly enlarged).

MOSQUITOES AND DISEASE.

It has been proved beyond all doubt that Mosquitoes are alone responsible for the conveyance of Malaria, Dengue Fever, and Yellow Fever. These Fevers are transmitted from person to person by certain species of Mosquitoes: Malaria by the species called Anophelines, Dengue Fever by the Culex, and Yellow Fever by the Stegomyia. Moreover, the experiments that have been carried out in South Africa concerning the transmission of Horse-sickness in Horses and Mules and Blue-tongue in Sheep, point conclusively to the fact that these diseases are also carried by Mosquitoes.

Apart from being a constant menace to health Mosquitoes are a source of great annoyance, and their extermination is called for in the interests of personal comfort.

Destroy all Mosquitoes without distinction, and all these Mosquito-borne Diseases will be eradicated.

A Mosquito-breeding pool. Look for the wrigglers in pools like this, and, if you find any, get rid of the water by draining, or spray the surface with paraffin once a week.

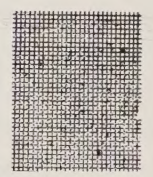
Dwelling-house showing verandah, windows and doors screened with wire gauze.

HOW TO DESTROY MOSQUITOES.

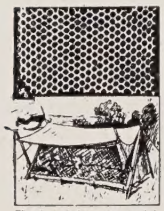
1. Mosquitoes breed **only** in water in pools, puddles, tubs, buckets, pots, tins, etc., wherever allowed to contain standing water. **Destroy their breeding places and you destroy the mosquitoes.**
2. Empty the water from all tubs, buckets, tins, vases, etc., once a week.
3. Fill in or drain all pools, puddles, and hollows where water is found to collect in the rainy season.
4. **Screen** with wire mosquito netting (mesh 16 or 18 to the inch) all openings of cisterns, wells, and tanks of water in everyday use.

(NOTE—The mesh of netting used is important. A larger mesh than 16 to the inch may not entirely prevent the entry of mosquitoes, whilst a smaller mesh than 18 to the inch unduly retards circulation of air. Phosphor bronze netting, although more expensive at first cost than ordinary painted or galvanized iron netting, is recommended as being much more durable, and cheaper in the end.)

5. Where pools or collections of standing water cannot be filled in or drained, spray the surface of the water with paraffin, which forms a film over the surface. The young or larva of the mosquito, known as a "wriggler", lives in water for ten or twelve days, and must come to the surface to breathe. Paraffin sprayed evenly over the surface of the water prevents the "wriggler" from breathing, and it dies. A condensed milk tin of paraffin is sufficient to cover a pool eight feet long by eight feet wide if well sprayed over.
6. Change regularly every week all water in troughs used for watering animals.
7. See that all guttering round the house is in good order, that it does not sag, and is not choked up with leaves or mud so that water collects in it.
8. Clear away all rank weeds and bush around your house and about water-courses, ditches, ponds, and other possible breeding places near your house, since these afford hiding places for the adult mosquitoes. Mosquitoes rarely travel more than half a mile from their breeding places.
9. Collect all old tins, buckets, bottles, jars, broken crockery, etc., around your premises, and have them buried in a convenient hole, which must be filled in.
10. Clear the adult mosquitoes out of your house by burning insect powder in the room, from which all curtains have been removed. The mosquitoes will be stupefied only, but may then be swept up and burnt.
11. Keep your house well lighted and ventilated. Mosquitoes do not like such; they prefer badly lighted and stuffy houses.



Size of wire gauze for screening windows, doors, verandas, water barrels, etc. (Ask for No. 16 or 18 gauge.)



When sleeping in the open use a camp-bed screened with mosquito netting. (Specimen size of netting shown.)

HOW TO PROTECT AGAINST THE BITES OF MOSQUITOES.

1. Always sleep under a mosquito net whether sleeping in a house, hotel, or on the veld. The net should be carefully tucked in under the mattress, and all the bedclothes arranged on top of the mattress—not tucked in under it—so that, no matter how much the sleeper kicks about the bedclothes, the mosquito net will be undisturbed. (See illustration for proper mesh of mosquito net.)
2. Screen with wire mosquito netting (mesh 16 or 18 to the inch) the windows, doors, and all openings in outside walls of houses and buildings occupied after sunset. (See note above regarding the proper mesh of netting.)

Interior of room showing window and door screened with wire gauze and bed with mosquito netting.

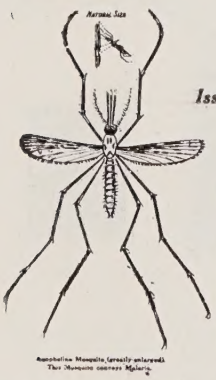
Keep your yard clear of old tins, bottles, etc., and screen the openings of water barrels with wire gauze.

PREVENTION OF MALARIA.

Although the greater part of South Africa is free from malarial fever there are certain areas in which it can be contracted during a portion of the year unless precautions are taken. Persons living in these areas need not fear infection if they observe the following precautions:—

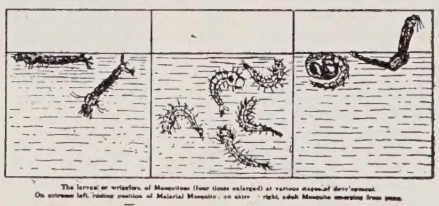
1. Screen the house or bed, or both, with proper mosquito netting, so that mosquitoes cannot enter and bite you. **It is only by the bites of mosquitoes that malaria is spread from one person to another, and the chief danger of infection is at night.**
2. Destroy all mosquitoes and mosquito larvæ, wherever found, by one or more of the methods already described.
3. Take regular doses of quinine during the fever season. Five grains of quinine taken regularly every day acts as a preventive of malaria.
4. Have your native huts, if possible, at least 500 yards away from your own house. The majority of natives, especially the children, are infected with the malaria parasite, and mosquitoes after biting them may convey the disease to you.

Write to the Secretary for further information or literature.



Natural Size

Anopheline Mosquito (greatly enlarged). This Mosquito conveys Malaria.



The larvæ or wrigglers of Mosquitoes (four times enlarged) at various stages of development. On extreme left, resting position of Malarial Mosquito; on extreme right, adult Mosquito emerging from pupa.

Natural Size

Tiger Mosquito (greatly enlarged). This Mosquito conveys Yellow Fever.

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(Some illustrations are due to the Liverpool School of Tropical Medicine for Sketches of Mosquitoes.)

Reduced facsimile of Wall Card, 20in. x 12½in., issued in English-Dutch and Zulu-Sesuto.

A Copy of this Card will be sent to anyone on application.

PUBLICATIONS ISSUED BY THE SOUTH AFRICAN ANTI-MALARIAL ASSOCIATION.

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No. 2.—"The Prevention of Malaria in the Northern Transvaal." By Dr. Henry L. Gordon.

No. 3.—"Report on Anti-Malarial Measures at Newington, Transvaal." By Dr. J. Stanley Avery.

No. 4.—"The Anopheline Mosquito." Hand-book for use in schools. By Mrs. R. C. Daughlish.

No. 5.—"A Summary of facts regarding Malaria." Suitable for School Teachers. By Sir Ronald Ross, K.C.B.

No. 6.—"Danger of Mosquitoes." Hanging wall-card, giving instructions regarding destruction of mosquitoes and protection against malaria. In heavy strawboard, varnished, for use in schools and public offices; also thin board edition for public distribution. (In English, Dutch, Zulu and Sesuto.)

No. 7.—"How to form and carry on Local Anti-Malarial Associations." Gives much useful information and ideas for local anti-mosquito campaigns.

No. 8.—"Mosquitoes and Malaria." By Jacobus C. Faure, B.S., M.A., of the Division of Entomology, Union Agricultural Department. (In English and Dutch.)

No. 9.—"Conquest of Malaria." The views of Surgeon-General Gorgas, Chief Sanitary Officer of the Panama Canal Commission. Recorded by Dr. William Macdonald. (In English and Dutch.)

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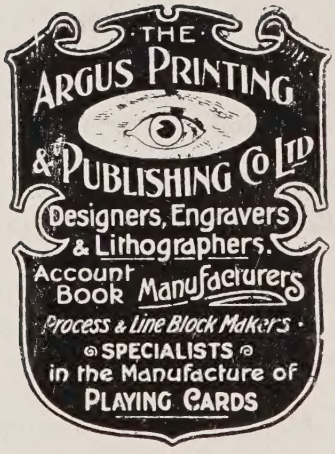
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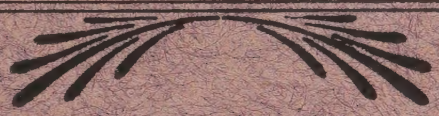

If you are, it is to your interest to assist in the formation of a Branch of this Association in your District.

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